

one of the most subtle and delicate of the "blue" colors, which the light is scattered by the fine particles of the atmosphere, giving rise to the blue color of the sky. This color is not due to the light itself, but to the particles of the atmosphere which scatter the light. The color of the sky is not due to the light itself, but to the particles of the atmosphere which scatter the light. The color of the sky is not due to the light itself, but to the particles of the atmosphere which scatter the light.

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THE BIOCHEMISTRY OF LIGHT

UPDATA THE BIOCHEMISTRY OF LIGHT

The question of the nature and the mechanism of the light reaction of photosynthesis has been the subject of much research in recent years. It is now generally accepted that the light reaction of photosynthesis is a process in which light energy is converted into chemical energy in the form of ATP and NADPH.

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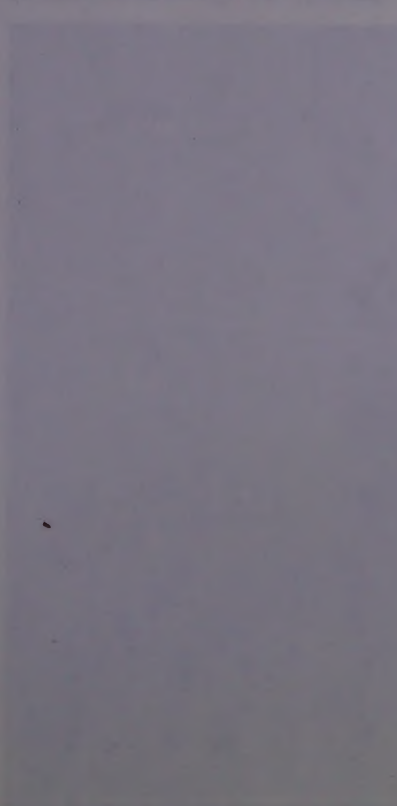
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By Kiester, Edwin

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ute of the scant light, and during the "blue hour," when the light is fading fast, she and the children hug the windows, painting, drawing or studying. Dinner comes at four P.M., but the children seldom venture outdoors afterward—for fear of the trolls, those evil dwarfs who live in the darkest part of the forest because sunlight turns them to stone. Mørketiden liberates them to perform their foul deeds anywhere, especially in a child's imagination.

The other end of the age spectrum also has its problems with mørketiden, as I learned at the Heracleum Eldre-

senter, a facility operated by the local pensioners' union. As most people know, sunshine is central to building strong bones. Rays falling on the skin convert a hormone into the substance we know as vitamin D, a necessity in calcium metabolism. Children who lack vitamin D develop a bone deformity called rickets. Less well known is the fact that vitamin D deficiency appears to accelerate osteomalacia, a shrinkage and softening of bone in older people that often leads to fractures. To combat both osteomalacia and arthritis, the center offers a program of

exercise, physical therapy, nutritious cafeteria meals and diet instruction. On the day of my visit, the menu featured fresh cod with liver and roe—the customary Norwegian supplementary source of vitamin D.

Tromsø has a tradition of keeping active during mørketiden. Mere darkness, for instance, is not allowed to interfere with love of the outdoors. Late one afternoon as I strolled through a suburban area of the city, I heard a

GEO DATA/THE BIOCHEMISTRY OF LIGHT

The biochemistry of light and the human body is not yet completely understood. Most of us have observed that we have a built-in "clock" that tells us when to sleep, eat and perform other bodily functions. The science of chronobiology has grown up to chart these daily cycles, called circadian rhythms (from the Latin for "about a day"), and to investigate which are innate, which are learned and which are responses to light and darkness. Among the phenomena observed are daily rhythms in sleeping and waking, body temperature, excretion of certain chemicals in the urine and secretion of adrenal hormones.

Repeated studies have shown that humans deprived of light cues (in caves or in sleep laboratories) establish their own internal clock, which runs in a cycle of about 25 hours and 15 minutes. Sleeping and waking and other cyclical functions adjust to the new routine. When the subjects are returned to a normal environment, they revert to 24-hour days, although some experience temporary problems of readjustment.

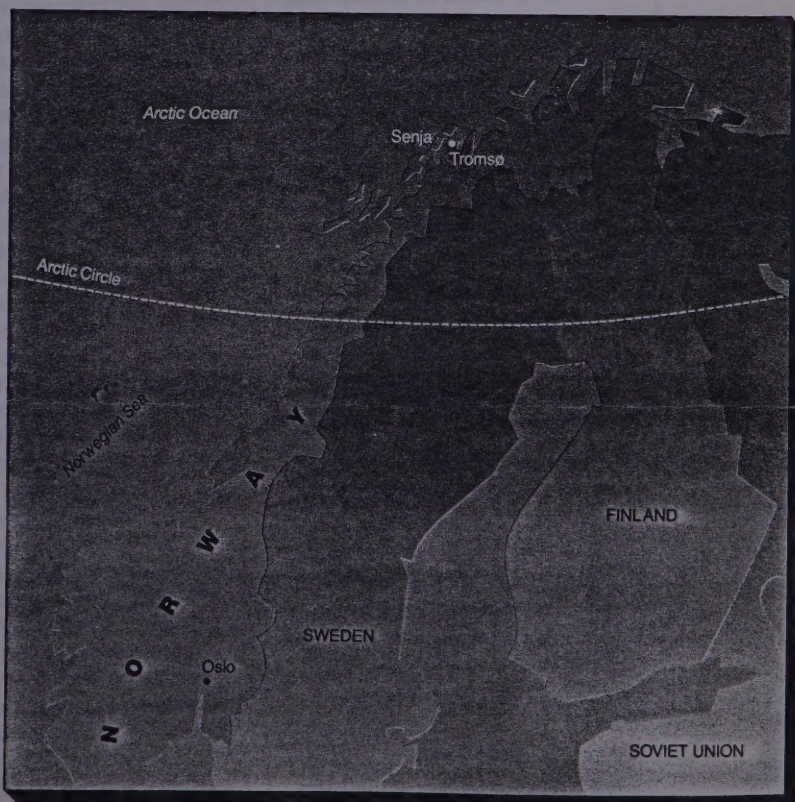
The seasons affect our behavior, too, possibly because of changes in the length of the days. Psychiatric disorders and certain physical illnesses, such as ulcers, increase in autumn. There is also evidence that humans are more fertile in summer.

The intriguing question is, How does the body regulate these events? Bio-

chemically, a full explanation is lacking. The most popular hypothesis is that light entering the body through the eyes and falling on the retina stimulates certain unidentified chemical receptors on the retina's surface. The stimulus then moves along a portion of the optic nerve through the hypothala-

mus (the brain center that governs a large portion of the endocrine system and such bodily functions as temperature, blood pressure, pulse rate and perspiration) to the pineal gland.

The role of the pineal gland in light-mediated events is now being investigated intensively. The pineal is a small



ge swishing sound and noticed a of overhead lights strung at in- across the hillside. Rounding a of firs, I found a line of cross- skiers huffing their way along dlighted trail.

ere is also a flurry of indoor activ- The university calendar is crowd- ith lectures, concerts, meetings, . "Mørketiden is a time of inten- work," said Åre Johnsen, the uni- ty's director of public affairs. best-attended lectures are in De- ber and January." Lingjaerde elab- ed: "The dark time is a stimulus

for social life. People have parties or dinners and family gatherings. They can't go into the mountains and do many of the things they do in summer, so they seek some sort of compensa- tion for living this unusual sort of life."

People seem almost to fear being alone. According to one study, Tromsø, with 45,850 people, has more than 4,000 restaurant seats, the largest per capita in Norway. The townspeople also spend more money on restaurant meals than do residents of any other Norwegian city. Restaurants close early in Norway (Tromsø's most popu-

n deep in the brain whose func- n humans has never been com- ly established. It is known, ever, that its hormone, melatonin, creted in darkness and sup- sed in bright natural light or arti- light. In animals, a decrease in tonin has been shown to cause— ation to seasonal patterns—an in- se in fertility. Some researchers ve that it may be related to hu- fertility as well.

th the help of these studies, agri- rists can now take advantage of onal patterns, such as new spring ths and mating cycles, by prolong- days through artificial means. One nple is the use of artificial light in production. By increasing day- hours, farmers are able to trick a s endocrine system into function- as though it were spring so that hen will lay more eggs.

ntil recently, scientific tests were accurate enough to measure pre- amounts of melatonin circulating e blood or excreted in the urine. , scientists at the National Institute ental Health and at the University egion Health Sciences Center laboratory have devised a more cting test and found that certain ple who suffer seasonal bouts of pression are especially sensitive to and show abnormal levels of mel- in. In one case, by lengthening a ent's winter days through pro- ed exposure to bright artificial

light, the researchers were able to lift his depression.

As for the physical changes brought about by the sun, they fall into two categories: good and bad. Sunshine has been called "the greatest carcinogen of them all," because prolonged expo- sure to the sun's rays can cause skin cancer. The incidence of this form of the disease, while one of the least viru- lent, is decidedly on the rise, especial- ly among fair-skinned people who insist on sunbathing. Sunshine, which promotes the synthesis of vitamin D, is also critical to calcium metabolism, and the lack of it can cause rickets in children during the bone-forming years and osteomalacia, or weakening of the bones, in the elderly, especially those confined indoors.

Through separating beneficial waves from damaging ones, scientists are learning that different types of light waves have different uses in the field of medicine. For instance, short-wave ultraviolet light (UV-C), which kills bac- teria, is used for sterilization in hospi- tals; middle-wave ultraviolet light (UV-B) is used as treatment for some skin diseases, primarily skin cancer, acne and eczema; long-wave ultravio- let light (UV-A), if used with the appro- priate drug, is an important ingredient in combating psoriasis; and blue light is now the standard treatment for neo- natal jaundice, a once fatal liver mal- function common in newborns, particularly those born prematurely.

lar eating place, the Fiskekrogen, stops serving at six-thirty P.M.), but every chair seems to be occupied ev- ery night.

Fortunately for the beleaguered city, Christmas comes along to bright- en the darkest days of mørketiden. "It is a very long Christmas," Åre Johnsen said. The festivities begin around De- cember 10 and don't wind down until mid-January.

Santa Claus and commercialism have come to Tromsø, but many age- old traditions linking the birth of Christ and the December 21 winter solstice survive. For example, the city fes- toons the entire main street in an arch of lights to remind people of the absent sun. Tromsø also carries out the tradi- tion of the Christmas feast. "It is two solid weeks of eating and drinking," one woman said, and then proceeded to enumerate the foods without which her Christmas table would be incom- plete. These included a cold table groaning with ham, beef and Norwe- gian cheese; at least four kinds of her- ring; the local shrimp in various salads and pâtés; Norwegian caviar; the marinated salmon *gravlaks*, for which each Norwegian appears to have his personal and secret recipe; smoked salmon and fermented trout.

Christmas itself lasts for three days. The family gathers on De- cember 24, the ex- citement of the children building throughout the day. In midafternoon, they are served a special Christmas porridge containing a single lucky al- mond. The child who discovers it will have good fortune throughout the year. At five P.M. the church bells ring in Christmas, and the tree is lighted, often with candles. The family joins hands and dances around the tree, after which gifts are distributed. Christmas Day is set aside for church and family, the next day for visits to friends and neighbors. The season continues with an elaborate New
(Continued on page 112)

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